

EXHIBIT H



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ANALYTICAL RESULTS REPORT
COLUMBIA FALLS ALUMINUM COMPANY
COLUMBIA FALLS, MONTANA
TDD FO8-8809-12
CERCLIS MTD057561763

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1.0 INTRODUCTION

This report has been prepared to satisfy the requirements of Technical Directive Document (TDD) F08-8809-12 issued to Ecology and Environment, Inc.'s, Field Investigation Team (E & E/FIT) by the Region VIII Environmental Protection Agency (EPA). This report addresses analytical results from data collected during drilling and sampling activities at the Columbia Falls Aluminum Company (CFAC) in Columbia Falls, Montana from June 7, 1988 through June 18, 1988. FIT members conducting the drilling and sampling included Robert Henry, project officer, Randy Perlis, site safety officer, Lynn Fischer, Diane Coker and Steve Yarbrough, samplers. Site access was coordinated by Karen Zackheim of the Montana Department of Health and Environmental Sciences (MDHES). Sampling procedures utilized during the investigation conform to the requirements established in the Region VIII Standard Operating Procedures for Sampling at Hazardous Waste Sites (SOP III-2). This sampling effort was conducted under the approved sample plan (TDD F08-8801-02).

2.0 OBJECTIVES

The objectives of this investigation were to, in part, characterize hydrogeologic conditions beneath the site. This was accomplished by the installation of two onsite monitoring wells. These wells, in conjunction with existing onsite wells, more accurately define the hydrogeologic conditions at the site. Ground water level data were also collected from existing test and production wells on and near the site. These data were used to assess local ground water flow patterns and determine ground water flow direction. Additionally, surface water,

sediment, soil and ground water samples were collected onsite and offsite in order to characterize the nature of contaminants and quantify the release of possible contaminants to offsite areas.

The FIT performed in-field analytical screening for fluoride, cyanide and hexavalent chromium during the site investigation. The analysis (EPA approved methods) was performed according to the 1986 Edition of the Hach Company Water Analysis Handbook. The analysis was performed on all surface water and ground water samples collected. Details regarding the screening analytical results can be found in section 7 for ground water and surface water quality.

The overall scope of this investigation involved the collection of nine ground water samples, five soil samples, seven surface water sample and nine sediment samples. Two rinsate blank samples, two trip blank samples and one triple volume sample were also collected for organic quality assurance (QA) purposes. Additionally, one triple volume and two blanks were submitted for inorganic QA purposes.

The organic and inorganic Contract Laboratory Program (CLP) samples collected during this investigation were shipped via Federal Express from Kalispell, Montana.

3.0 BACKGROUND

3.1 LOCATION AND SITE DESCRIPTION

The Columbia Falls Aluminum Company site (Figure 1) is located in Section 3, Range 20W, Township 30N with latitude coordinates 48° 20' 01" N and longitude coordinates of 114° 07' 52" W. It is bounded by Teakettle Mountain, Flathead River and Cedar Creek to the east, south and west respectively. The CFAC site covers approximately 120 acres and is located 1.5 miles north east of Columbia Falls (population 3,112 from 1980 census) in Flathead County, Montana. The elevation at the site is 3100 feet AMSL. The topography at the plant is relatively flat with a southern slope at about 3° to 4°. Analysis of aerial photographs show

the topography north of the site is steeper, dipping south at approximately 5°-6°.

3.2 PREVIOUS WORK

The FIT conducted a visual inspection of the CFAC site on December 17, 1987. A Preliminary Assessment (PA) was also completed by the MDHES on March 5, 1984. The PA indicates that "hazardous wastes produced at the facility are spent halogenated solvents and contaminated gasoline. Solid wastes include spent pot liners, basement sweepings and air pollution control dust." The EPA and the MDHES (air quality and water quality division) have conducted numerous visits concerning airborne contaminants and as part of the Montana Ground Water Pollution Control permitting.

3.3 SITE HISTORY

The Columbia Falls Aluminum Company plant began operations in 1955 and is operational today. The facility was owned and operated by Atlantic Richfield Company until 1985 at which time it was sold to CFAC. The plant produces aluminum by means of a cathode anode system. The cathode cell is lined with black carbon that when in contact with aluminum oxide reduces to aluminum. Each cathode has a life of 5-7 years. There are currently 600 cathodes operating simultaneously with 1 or 2 cathodes being taken out of service every week. Forty tons of waste product (carbon) is removed from each cathode. Ken Reich (1987), environmental coordinator for CFAC indicated that cyanide is present at 1% in each cathode cell. Fluoride is also evident at 17% waste product in the form of sodium aluminum fluoride. According to the 1988 RCRA master list, the CFAC site is known to generate halogenated and non-halogenated solvents. CFAC does not have underground injection control nor is it a hazardous waste treatment, storage or disposal facility. The plant applied for and received a Montana Ground Water Pollution Control Permit (MGWPCS005) in 1984.

Significant environmental features onsite include percolation ponds, leachate ponds, closed and operational landfills. Prior to 1978 the carbon cathodes were soaked in water in order to expedite the carbon removal process. Waste effluent from this process was piped to the boiler blowdown pond (Figure 5). The adjacent infiltration pond was used as an overflow receptacle from the boiler blowdown pond. Quarterly ground water monitoring by CFAC indicate a decrease in fluoride and cyanide concentrations after 1978. Information obtained from Ken Reich (1987) indicates that, currently the boiler blowdown pond is used as a receptacle for non-contact cooling water. The south percolation ponds receive cast cooling water and sewage treatment effluent from the plant. In the fall of 1980 the onsite closed landfills were taken out of operation, capped and revegetated. Solvents are known to have been deposited in these once operational landfills. The landfill currently operating is lined with clay. The spent pot liners used in the reduction of aluminum were deposited in the spent pot liner landfill. Two leachate ponds were constructed in 1980 north and south of this landfill. The sanitary landfill is currently in use to receive plant garbage.

4.0 SITE GEOLOGY, HYDROLOGY, HYDROGEOLOGY AND METEOROLOGY

4.1 GEOLOGY

4.1.1 Regional Geology

The site is situated in the northeast section of the Kalispell Valley, a northwest, southeast trending intermontane basin. The Kalispell Valley is 28 miles long by 7 miles wide at the south and approximately 15 miles wide in the central and northern regions. According to Fenneman (1931) the valley is in the Northern Rocky Mountain Physiographic Province. The Kalispell Valley was formed as a result of normal faulting preceded by late Paleocene to Eocene compression induced folding and thrust faulting evident in the Whitefish Range and Glacier Park Basin to the north and south respectively (Konizeski, 1968).

The mountains bordering the Kalispell Valley and the Kalispell Valley Basin bedrock are comprised predominantly of partially metamorphosed Precambrian Rock. These once sedimentary rocks are composed of gray to greenish-gray argillite and light gray quartzite of the Ravalli group, Lower Belt series, (Konizeski, R.L. et.al., 1968). A report prepared by Hydrometrics of Helena, Montana, (1985) suggests that these basement rock are tightly compacted, exhibiting very low permeability and porosity and have a total thickness of tens of thousands of feet.

The Kalispell Valley was further shaped by middle Wisconsin Cordilleran and Alpine glaciation. Konizeski, R.L. et. al., (1968) suggests that the British Columbian derived Cordilleran Ice sheet advanced into the Kalispell Valley from the northwest corner near Whitefish. The Cordilleran Ice lake subsequently coalesced with the Glacier Park derived Flathead Alpine glacier at Bedrock Canyon, and moved south into the Kalispell Valley. Glacial recession in middle Pinedale time led to the formation of Glacial Lake Missoula, inundating the entire Kalispell Valley. Wisconsin age glaciation, including glaciolacustrine and periglacial features were subsequently mantled by clay, silt and sand deposited in glacial Lake Missoula. As Glacial Lake Missoula subsided, the Flathead River and its tributaries entrenched their courses into the unconsolidated glacial drift, depositing residual drift and alluvial materials (Figure 2).

4.1.2 Local Geology

The CFAC site is located approximately 1/2 mile northwest of Badrock Canyon. Teakettle Mountain (Figure 1), the principle geologic feature in the area located 1/4 mile due east of the site, is comprised of primarily Precambrian undifferentiated sedimentary strata of the Ravalli Group superimposed by the Piegan Group dolomites (Hydrometrics, 1985).

The Quaternary stratigraphy near the site is locally complicated due to the heterogeneous nature of glacial and alluvial deposits. Based on

well logs from the CFAC site, bedrock is estimated to be variable from 145 feet to 300 feet.

Alden (1953), suggests the area near Columbia Falls is underlain by primarily glacial till deposited by the Cordilleran Ice Sheet. Konizeski (1968) further suggests that the substratum near Columbia Falls is characterized by "ice-contact, drumlin-forming clay and boulder till; locally overlain by glaciolacustrine deposits" (Figure 2). The glaciolacustrine deposits mentioned by Konizeski (1968) are those derived by Glacial Lake Missoula. Based on local well logs, the glacial drift, glacial till and glaciolacustrine deposits are inferred to be interfingered at and near the CFAC site. Pleistocene glaciofluvial outwash and recent alluvial deposits overlying the glacial stratigraphy are found to exist near the southern border of the CFAC site. Additional alluvial deposits can be found in the Cedar Creek floodplain (Figure 2). Hydrometrics (1985) suggest that "the Flathead River and Cedar Creek flow primarily through Recent alluvium consisting dominantly of silt and sands comprising the modern floodplains."

4.2 HYDROLOGY

The Flathead River and Cedar Creek are the two surface water bodies of concern near the CFAC site. The Flathead River is located approximately 1/4 mile south of the site. The north and middle forks of the Flathead River originate in Glacier National Park and flow south from Glacier National Park where they meet the South Fork at the mouth of Badrock Canyon. The Flathead River flows west through Badrock Canyon to Columbia Falls where it's course is southerly to Flathead Lake. Based on information obtained from Hydrometrics (1985), the Flathead River streamflows are regulated in part by Hungry Horse Reservoir located on the South Fork, Flathead River. A 9,778 ft³/sec average annual discharge of the Flathead River at Columbia Falls is reported by the USGS Gaging Station No. 12363000. The dominant water quality problem in the Flathead River near the site is due to large temperature fluctuations of cold water releases from Hungry Horse Reservoir (Nunnallee, et.al. 1976). Flathead River water quality is also dictated

by heavy sediment loads in the middle fork of the Flathead River during spring runoff. Heavy logging activity in the north fork area results in a phosphorous content twice that of the Middle Fork. Hydrometrics (1985) indicate that water quality in the Flathead River, at Columbia Falls is considered moderately hard, calcium bicarbonate water with low concentrations of sodium and trace metals.

Water rights data obtained from the Montana DNRC indicate that within four miles downstream of the site, the Flathead River is diverted for the following: irrigation (653 acres) and stockwatering (120 animal units). The Montana Department of Fish, Wildlife and Parks (DFWP) also has approximately 75 diversions on the Flathead River. The use of the diverted water by the DFWP is classified as "fish and wildlife."

The second surface water body of concern near the CFAC site is Cedar Creek and Cedar Creek Reservoir. Cedar Creek originates well north of the site in Whitefish Mountain Range. Information obtained from the city of Columbia Falls indicate that the Montana Soil and Conservation Service constructed a reservoir on Cedar Creek (Figure 1) approximately 2 miles north of the site as a means of flood control and potable water storage in the early 1960's. Cedar Creek flows southwest from the reservoir to the town of Columbia Falls where it is used as their primary domestic water source. The Cedar Creek municipal water supply pumping station is depicted in Figure 1. Flood control on Cedar Creek and Cedar Creek Reservoir is accomplished by means of a drainage ditch that flows south from the reservoir and passes within 200 yards of the spent pond lined leachate pond complex and less than 1/4 mile east of the site before discharging into the Flathead River.

In addition to Cedar Creek being the main domestic water supply for Columbia Falls, it is also diverted below Cedar Creek reservoir for the irrigation of approximately 15 acres.

Cedar Creek was of paramount concern under this investigation because it is used as the domestic water supply for Columbia Falls and that the site is situated topographically level with the Cedar Creek

drainage. Obvious overland flow of contaminants was not observed during the investigation.

4.3 HYDROGEOLOGY

4.3.1 Ground Water Occurrence and Distribution

As previously mentioned in Section 5.1 of this report, the Flathead Valley has undergone several distinct erosional, depositional and geologic events. Ground water occurrence and distribution in the Flathead Valley is largely dictated by Precambrian bedrock, Pleistocene Glacial Deposits and recent alluvially deposited materials. The nature of glacially and alluvially deposited materials in the Flathead Valley results in a very complex hydrogeologic setting.

The Pleistocene glacial deposits mantle most if not all of the Flathead Valley. The glacially deposited material influence greatly the occurrence and distribution of ground water in the valley. Due to the complex depositional nature of the glacial, peri-glacial, glaciofluvial and glaciolacustrine deposits in the valley, ascertaining exact hydrogeologic relationships of aquifer systems is difficult. Konizeski, et.al. (1968) identified five major aquifer systems within the Flathead Valley. For continuity, the terminology of Konizeski, et.al. (1968) will be retained for describing the regional hydrogeologic setting, however, this scheme may not strictly apply when evaluating the aquifer of concern. The five aquifer systems of Konizeski, listed in descending order are as follows (Figure 2):

- 1) Recent floodplain aquifer - includes alluvium of the Flathead River and major tributaries (mapping unit Qal).
- 2) Pleistocene Perched Aquifers - includes the glaciolacustrine and glacial drift deposits of the east valley terrace. This aquifer system consists of at least two and possibly more individual aquifers (Mapping units Qgl and Qgdb)

- 3) Pleistocene Shallow Artesian Aquifer - A locally important outwash of sand and gravel that underlies glacial drift in areas of the valley.
- 4) Pleistocene Deep Artesian Aquifer - includes interfingering sand and gravel beds beneath the Pleistocene Shallow Artesian Aquifer or glacial drift.
- 5) Precambrian Bedrock Aquifer - All belt series sedimentary rocks bordering and underlying the valley (mapping unit Pcb).

Hydrometrics (1985) installed a series of piezometers in order to gain a better understanding of onsite subsurface depositional relationships. The piezometers "show a succession of till and small patches of glaciolacustrine clays, capped by from one foot to greater than twelve feet of imbricated glaciofluvial and alluvial sands, gravels and cobbles. This capping unit appears to be more extensive and thicker north and west of the plant complex than it is to the northeast." The retrieval of cutting samples during drilling confirmed the heterogeneous nature of the substratum. Drillers logs obtained from the MDNRC provide more evidence of the complex heterogeneous depositional modes. The logs indicate that from 70 to more than 300 feet of interbedded glacial, glaciofluvial and glaciolacustrine sediments underlie the CFAC site. Extrapolation of the logs also indicate that these glacially related units are vertically and laterally discontinuous. A buried glacial outwash channel, consisting of cobbles and gravels emanating from bedrock canyon and evident along this southern border of the CFAC site, is host to a highly transmissive water bearing zone at depths greater than 100 feet. The depth to ground water is variable at the site. Water table depths of 15 feet are evident in CFAC monitoring wells located approximately 100 feet north of the Flathead River. Additionally, a ground water level of 100 feet was recorded by Hydrometrics (1985) in a test well located between the spent pot liner landfill and the sludge pond (Figure 1). Both water level measurements were taken in August, 1985. Extrapolation of water level measurements

(Hydrometrics 1985) indicate a southwest ground water flow direction (Figure 3).

As part of the objectives of this investigation, potentiometric data were compiled for the purpose of assessing the local ground water flow direction. The FIT utilized the services of Flathead Land Consultants (registered land surveyors, License #54285) of Kalispell, Montana to establish vertical elevation control at four on-site wells. The wells surveyed include CF-MW-1, CF-MW-2, TW-2 and TW-8. Elevation control was established at these wells because they afford the best hydrogeologic coverage. The elevations at each well were measured at a reference mark on the well using a Leitz Sokkisha C3A Automatic Level. A USGS benchmark relating true elevation in the area was unavailable, thus a marked elevation of 3111.41 feet was taken from the CFAC sewage treatment facility located south of the plant buildings. From this reference point, the above specified wells were surveyed by closed loop traverse for potentiometric contouring purposes. The reference mark elevation of all wells are listed below.

WELL	ELEVATION (FT)	LOCATION
CF-MW-1	3168.36	cement pad at
CF-MW-2	3104.13	base of well
TW-2	3104.08	steel spout from
TW-8	3164.31	dedicated pump line

All water level measurements were taken on 6/17/88.

Based on water level data and the above elevation data, the FIT prepared a potentiometric surface map of the shallow alluvial aquifer at the plant (Figure 4). Due to a lack of data points in certain areas, the potentiometric contour lines in these areas are, for the most part, inferred from site observations and field water quality data. As depicted in Figure 4, the inferred ground water flow is generally toward the southwest. Correlation of this potentiometric contour map is very

consistent to the potentiometric contour map prepared by Hydrometrics (1985).

An aquifer test conducted by Hydrometrics indicate that ground water yields at the CFAC site are highly variable ranging from over 1500 gallons per minute (gpm) to only a few gpm. Wells yielding greater quantities of ground water are those located closer to the Flathead River. This large variability in ground water yield is due to the heterogeneous nature of glacial deposits underlying the site. Commensurate to ground water yield, Hydrometrics also established transmissivities ranging from several thousand gallons per day per foot (gpd/ft) to less than 100 gpd/ft.

Recharge to ground water beneath the site occurs by precipitation infiltration and infiltration of ephemeral streams on the west flank of Teakettle Mountain (Figure 1), and by surface water from Cedar Creek. As is evident in Figure 3, ground water discharge is principally to the Flathead River. Ground water discharge also occurs by withdrawal from wells in the area. Water rights data obtained from the MDNRC show that there are approximately 445 domestic wells utilized by households within four miles downgradient of the site. Of the 445 domestic wells downgradient of the site, 30 wells are used by a small grouping of 33 homes located 1 mile west of the CFAC plant.

The town of Columbia Falls utilizes three municipal ground water wells as a secondary potable water supply. Two of the municipal wells (municipal well 2 and 3) are located due east of the Columbia Falls city limits and approximately 300 yards west of the Flathead River. These wells are located 2 miles downgradient of the site and are completed in shallow alluvial material at depths of 31 and 31.5 feet respectively. The third back up well (municipal well No. 4) is located west of Columbia Falls and approximately 3 1/4 miles southwest of the CFAC site. Municipal well #2 was sampled as part of this investigation and is discussed further in Section 9.2 of this report.

4.3.2 Ground Water Quality

As part of the Montana ground water pollution control permit (MGWPCS 005), limited quarterly ground water monitoring is conducted to determine ground water quality from selected test and monitoring wells. Ground water quality parameters tested include, pH, specific conductance, fluoride, antimony, cyanide and benzo(a)pyrene. The sampling parameters historically tested at the site are no substitute for the Hazard Substance List (HSL) compounds, however, pH, specific conductance, fluoride and cyanide are useful to characterize the effects of plant discharge to the ground water.

Measurable concentrations of cyanide and fluoride are evident in ground water downgradient (TW-1 and TW-2) of the north percolation ponds. As previously mentioned, water used to soak spent pot liners was disposed of in the north percolation pond (east pond). This activity, discontinued in 1977, is the most likely source of the cyanide and fluoride concentrations. A further discussion of the North Percolation Pond is presented in Section 9.3 of this report. Increased concentrations of fluoride in ground water are also shown (Hydrometrics, 1985) to have come from the south percolation ponds (Figure 1). Antimony concentrations detected in ground water at the site is probably of background quality as it is not used in the plant processes.

4.4 METEOROLOGY

All data presented in this section was obtained from the Climatic Atlas of the United States, U.S. Department of Commerce, Environmental Sciences Services Administration, Environmental Data Service, June, 1968. The climate in Columbia Falls and at the CFAC site is characterized by large fluctuations in temperature and precipitation throughout the year. Mean monthly temperatures range from 5 degrees Fahrenheit (°F) in January to 75°F in July and August. During May and June the average temperature is approximately 50°F. Precipitation in the Columbia Falls area varies from a mean monthly amount of 1.22 inches in April to 2.34 inches in June. The annual prevailing wind direction

is variable with winds at approximately 6 mph from the northwest during October through January. During February through September the prevailing wind direction is from the west at 6 mph. Relative humidity in the area fluctuates from 80% in January and February to 50% in July and August. Barometric pressure ranges from 1020 millibars (30.12 inches of mercury) in January to 1012 millibars (29.88 inches of mercury) in June.

5.0 WELL DRILLING AND INSTALLATION

A total of two monitoring wells were drilled as part of this site investigation. On-site supervision of drilling activities was conducted by FIT members Robert Henry and Randy Perlis from June 7 through June 15. Well drilling was performed by B&B Drilling of Libby, Montana under subcontract TDD F08-8804-08. All drilling activities were conducted in level D respiratory and dermal protection under generally favorable summer weather conditions.

For this investigation, two monitoring wells, designated CF-MW-1 and CF-MW-2 were installed in accordance with the approved sample plan issued under TDD F08-8801-02. CF-MW-1 was drilled to assess background conditions and CF-MW-2 was drilled and installed as a downgradient monitoring station. A third monitoring well, CF-MW-3, was deleted from the drilling program due to the favorable location of an existing test well near the leachate pond/spent potliner complex. The well locations closely conformed with the proposed locations identified in the sampling plan. Figures 4 and 5 illustrate the final locations of monitoring wells drilled at the site.

Each monitoring well was installed with a Bucyrus-Eric air rotary/casing drive rig equipped with a Hankison Model 1309 in line oil removal filter. During drilling, each borehole was logged according to lithologic characteristics, depth to water and measured organic vapor concentrations using the OVA. Individual well designs, particularly the screened interval were selected an apparent depth to water estimated

during drilling. Appendix C contains information which summarizes drilling log and well construction details for CF-MW-1 and CF-MW-2.

Monitoring well CF-MW-1 was completed with 2-inch ID PVC casing and 20 feet of 2-inch ID, 0.010 slot flush-threaded PVC screen with bottom cap. The sand pack was poured to a depth of 2.5 feet above the screen in CF-MW-1 using 10-20 mesh Colorado Silica Sand supplied by Colorado Silica Sand, Inc. of Colorado Springs, Colorado. A bentonite seal was established above the sand pack using 4 feet of Volclay 1/4 inch pellets. Monitoring well CF-MW-2 was completed with 2-inch ID PVC casing and 15 feet of 2-inch ID, 0.010 slot flush threaded PVC screen with bottom cap. The sand pack in CF-MW-2 was poured to a depth of 4.3 feet above the screen using 10-20 mesh Colorado Silica Sand. The bentonite seal in CF-MW-2 was placed above the sand pack at a total depth of 2.3 feet using Volclay 1/4 inch pellets. Neat cement grout was poured to the surface using a Type I and II Portland cement/bentonite slurry. Finally, a protective steel casing with weephole and locking cap was installed over the PVC casing (Figure 6).

Decontamination of drilling equipment was accomplished using a steam cleaner followed by a methanol rinse, distilled water rinse and metals free water rinse. For the methanol rinse phase of decontamination, a temporary collection pad was used to prevent soil contamination. Excess solvent was allowed to evaporate in-place eliminating the need for disposal of solvent rinsates.

The upgradient/background monitoring well, designated CF-MW-1, was drilled approximately one-mile north of the CFAC plant. Heavy vegetation between the closed landfill and CF-MW-1 (Figure 5) dictated the access and placement of the well location. Subsurface lithology in the CF-MW-1 boring was primarily sand grading to cobbles from 0 feet to approximately 30 feet in depth. A perched water table was evident at 11.5' to 12'. Tan plastic clay was evident in the cuttings reaching 75% of the matrix at 65 feet in depth. Water was encountered at 142 feet. The clay encountered during drilling acted as a confining layer as the water level stabilized at depth of 96.74 feet below ground surface. All

drill cuttings were monitored with the OVA; however, no readings above background were measured during drilling and well installation activities.

The downgradient monitoring well, CF-MW-2 was drilled 100 yards southwest of the North Percolation/boiler blowdown pond. Subsurface lithology in CF-MW-2 was characterized by fine to coarse grained sand grading to pebbles and broken cobbles. The initial water level was encountered at approximately 42 feet which later stabilized to a static level of 38.35 feet. Monitoring with the OVA detected no organic vapors greater than background.

A Monotox cyanide detector was also used for health and safety reasons during the drilling and installation of the wells, however, no cyanide was detected in either boring headspace.

Well development was accomplished by overpumping using a portable PVC hand operated pump. This pump operates on a positive displacement principle and has a maximum rated capacity of 5 to 6 gpm at low heads. Monitoring well CF-MW-1 yielded 0.5 gpm during development. At the completion of well development, CF-MW-1 produced light brown, cloudy water with minor suspended silt. Monitoring well CF-MW-2 also yielded 0.5 gpm during development with water appearance of a light brown color, cloudy with minor suspended sand at the end of development. Monitoring with the OVA during development activities at the wells revealed no vapor concentrations above background. As evidenced by turbid water in the samples collected under this investigation, complete well development may not have been fully achieved, however ground water turbidity may be a natural state.

6.0 SAMPLING ACTIVITIES

6.1 SAMPLE COLLECTION

The FIT arrived at CFAC at 0800 on June 6, 1988. FIT members Robert Henry and Randy Perlis met with representatives from CFAC and ARCO to

discuss the drilling and sampling program and conducted an initial site reconnaissance of the facility and surrounding areas. Split samples were collected by Ken Reick of CFAC and Gene Mancini of ARCO, who were present during all drilling and sampling events. Sample collection began on Saturday, June 11, 1988. FIT members conducting the sampling included Robert Henry, Randy Perlis, Diane Coker, Lynn Fischer and Steve Yarbrough. Sample collection was conducted in Level "D" protection as prescribed in SOP III-2 with the exception of the following: soil samples CF-SO-1 and CF-OP-2 were collected in Level "C" respiratory protection from the spent pot liner landfill.

Nine ground water samples, seven surface water, nine sediment and five soil samples were collected from onsite and surrounding area locations.

6.1.1 Ground Water Samples

Prior to ground water sample collection, three casing volumes were evacuated from each well. During this purging process, pH and specific conductance measurements were taken until the respective water quality parameters became consistent. Two monitoring wells were installed (see Section 4.0 of this report) in order to characterize, more accurately, ground water conditions on-site. Monitoring well CF-MW-1 was drilled and completed 1 mile north (hydrogeologically upgradient) of the CFAC plant. This well will serve to characterize background conditions in the plant area. The second well installed under this investigation (CF-MW-2) was drilled and installed 100 yards southwest of the North Percolation/Boiler blowdown pond. The installation of a well at this location, in conjunction with existing wells will serve as an on-site downgradient well. Monitoring wells CF-MW-1 and CF-MW-2 were purged by means of the hand operated PVC pump. Sample collection was accomplished by means of a 3 foot properly decontaminated stainless steel bailer.

Several existing monitoring (test) wells were also sampled under this investigation. These wells include TW-2, TW-3 TW-8, TW-10 and TW-11. Onsite ground water conditions are represented by TW-3, TW-8 and

TW-10. The collection of ground water samples from these wells were useful in determining contamination from the closed landfill and spent pot liner/leachate pond complex. Offsite migration of potential contaminants will be evident in samples collected from TW-2 and TW-11. The wells discussed in this paragraph all have dedicated pumps, thus the utilization of a stainless steel bailer for sample collection was impossible.

Columbia Falls Aluminum Company uses a production well, located 1/4 mile north of the Flathead River for a potable water source and for use in the aluminum manufacturing process. Sample PW-7 was collected at this location and was used to determine possible ground water contaminant migration to the Flathead River drainage.

The last well sampled during the investigation was a municipal well used as a backup potable water supply for the town of Columbia Falls. The well is located 1.5 miles hydrogeologically and hydrologically downgradient of the CFAC Plant. The purpose of collecting this sample (Muni #2) was to ascertain the downgradient migration of possible ground water contaminants to the Columbia Falls water supply.

All ground water samples being analyzed for inorganic parameters were field filtered with a 0.45 micron membrane filter and preserved with nitric acid (HNO_3 , for metals analysis) or sodium hydroxide (NaOH , for cyanide analysis) prior to being placed in the appropriate sample bottles.

6.1.2 Soil Samples

The FIT collected three soil samples during the investigation. Two opportunity soil samples were also collected upon reconnaissance of the site. Soil sample CF-SO-4 was collected 150 yards north of the closed landfill and will serve to characterize background soil conditions near the site. Soil sample CF-SO-2 was collected at an augered depth of 2.5 feet in the closed landfill. Soil sample CF-SO-1 was collected in Level C protection from the spent pot liner landfill. According to Mr. Ken

Reick (CFAC representative) the sample collected is fly ash material taken from the facility's dry scrubber system. It was the original intent of the FIT to collect spent cathode material which was accomplished by the collection of sample CF-OP-2. This sample was also collected from the spent pot liner landfill. Another opportunity sample (CF-OP-1) was collected at an augered depth of 1.5 feet in the Sludge Pond. This pond has been covered with a native soil covering of approximately 1 foot in depth. Soil sample CF-SO-3 was deleted from the sampling event due to the very coarse nature of the covering material.

The soil samples were collected as grab samples using a stainless steel scoop or scoopula and placed into the appropriate sample containers.

6.1.3 Surface Water and Sediment Samples

Surface water and sediment sampling locations conformed very closely to those depicted in the sampling plan. Surface water/sediment sample collection began at the upgradient/background location on the Flathead River. These samples CF-SW-9/CF-SE-9 were collected approximately 0.5 miles east of all plant operations. Samples CF-SW-2/CF-SS-2 were collected from Flathead River backwater adjacent to the South Percolation ponds. The third and final surface water/sediment sample obtained from the Flathead River was collected at a downgradient location. These samples, designated CF-SW-3 and CF-SE-3 were originally scheduled to be sampled approximately 0.25 miles downstream from the plant. Due to inaccessibility to the River, these samples (CF-SW-3 and CF-SE-3) were collected 2 miles downstream.

Background surface water and sediment conditions for Cedar Creek and the flood control ditch were characterized by the collection of CF-SW-5 and CF-SE-5. These samples were collected at the base of Cedar Creek Reservoir at the start of Cedar Creek. Sediment samples CF-SE-4 and CF-SE-1 were taken to ascertain contaminant migration via the flood control ditch. As previously mentioned, the flood control ditch is used to divert high water from Cedar Creek. At the time of sample

collection, no surface water was available at the CF-SW-4 and CF-SW-1 locations. Sediment sample CF-SE-4 was collected approximately 100 feet south of the southern leachate pond. The sediment had a reddish color similar to the color of the material in the leachate ponds, however no readings above background were evident with the OVA. Sediment sample CF-SE-1 was scheduled to be taken at the confluence of the flood control ditch and the Flathead River, however upon site reconnaissance, it was discovered that the ditch flows into a culvert 75 yards north of the railroad tracks which then flows to the Flathead River. No sample material was available at the end of the culvert, consequently, CF-SE-1 was collected where the ditch flows into the culvert. Surface water and sediment sample CF-SW-6 and CF-SE-6, collected downgradient of the facility in Cedar Creek served to determine contamination of Cedar Creek. Onsite surface water bodies were also sampled in order to characterize the nature of possible contaminants being deposited. Surface water and sediment sample CF-SW-8 and CF-SE-8 were collected from the westernmost south percolation pond. Contact cooling water and sewage effluent is piped from the plant to this pond. The north percolation/boiler blowdown pond was also sampled. Surface water and sediment samples CF-SW-7 and CF-SE-7 were collected at the point where the non-contact cooling water is piped to the pond.

The surface water samples were collected by completely immersing the sample bottle into the surface water body. Sediment samples were collected with a properly decontaminated stainless steel scoop or scoopula and placed into the appropriate sample container.

6.2 QUALITY CONTROL

The FIT maintained the integrity of each sample by following extensive decontamination procedures prior to the collection of each sample. In addition, the FIT prepared two rinsate blank samples (CF-MW-4 and CF-MW-5), one triple volume sample (CF-SW-8) and two trip blank samples (CF-MW-6 and CF-MW-10). One triple volume sample (CF-MW-8) and two rinsate blank samples (CF-MW-4 and CF-MW-5) were also collected for the inorganic fraction of analysis. These samples were

collected as specified under the approved sample plan. The blank samples were prepared by pouring organics-free and metals-free water over and through properly decontaminated sampling equipment. The water was then collected into the appropriate sample container.

6.2.1 Sample Containers

The sample containers used for this investigation included: 40 milliliter VOA vials, 80 ounce amber bottles, 1 liter plastic poly bottles (metals fraction for water samples) and 8 ounce glass jars. The sample containers were obtained through the Sample Management Office (SMO) Sample Bottle Repository (I-Chem and Eagle Pitcher).

6.2.2 Background Samples

Background samples collected for this investigation will be used as a basis for analyzing the data from samples collected at downgradient locations. The collection of samples CF-MW-1, CF-SO-4, CF-SW-9/CF-SE-9 and CF-SW-5/CF-SE-5 represent the background samples for ground water, soil and surface water/sediment respectively.

6.2.3 Instrument Calibration

The Organic Vapor Analyzer (OVA) used for general site safety work was calibrated in accordance with the FIT/OVA Field Manual for survey mode operations. The pH meter was calibrated using pH 4, pH 7 and pH 10 standards. The conductivity meter was also calibrated with standards of 37.5, 375 and 3750 micromhos/cm.

6.3 DOCUMENTATION

After collection, all samples were handled in strict accordance with chain of custody protocol described by the NEIC Procedures Manual for the Evidence Audit of Enforcement Investigation by Contractor Evidence Audit Teams, April, 1984 (EPA-330/9-81-003R). Tables 1 to 6 of

Appendix A summarize sample documentation, including sample numbers, sample tags, traffic reports and chain of custody numbers.

7.0 ANALYTICAL SCREENING

As previously mentioned, the FIT utilized field water quality screening procedures in order to more accurately understand the ground and surface water conditions on-site. The screening procedure was conducted to analyze for fluoride, cyanide and hexavalent chromium. All of the wells sampled exhibited concentrations of fluoride (excluding CF-MW-1 which had no measurable concentration of fluoride) ranging from 0.1 mg/l in the Columbia Falls municipal well (Muni #2) and CF-MW-2 to 5.5 mg/l in the existing test well TW-2. Also notable in the fluoride analysis is a concentration of 4.5 mg/l in the CFAC production well located approximately 1/4 mile north of the Flathead River. A correlation of this data to data collected by CFAC in April, 1988 shows that the fluoride concentrations have increased in all ground water samples collected. Table 15 (Appendix A) of this report depicts the FIT screening results in comparison to data collected by CFAC in April, 1988. Screening results for cyanide indicate its presence in only TW-2 (0.015 mg/l) and PW-7 (0.0025 mg/l). In correlation to CFAC's April, 1988 data, these concentrations have decreased. No concentrations of hexavalent chromium were detected during the screening procedure. The data collected during the screening procedure is not a substitute for CLP data and will only be used for correlative purposes.

The CFAC site also contains surface water bodies that were sampled under this investigation. Five percolation ponds are currently used as a receptacle for cooling and waste water from the plant. A review of the screening data indicates the presence of fluoride in all of the surface water samples collected. Table 16 (Appendix A) of this report depicts the results in comparison to sampling conducted by CFAC in April of 1988. As is shown in Table 16, the fluoride concentrations are variable from 0.1 mg/l in downgradient surface water from Cedar Creek to 5.0 mg/l in surface water collected from the Flathead River adjacent to the south percolation ponds. Screening analysis for cyanide and

hexavalent chromium show no concentrations detected in surface water sampled.

8.0 QUALITY ASSURANCE REVIEW

All samples, excluding CF-OP-1 and CF-OP-2, were deemed low concentration environmental samples. Appendix B of this report contains the data sheets and quality assurance reports that are discussed herein. The data packages were reviewed by a FIT chemist according to the EPA Functional Guidelines for Reviewing Organic and Inorganic Analysis. The findings were as follows.

8.1 ORGANIC DATA

The organic data was found to be acceptable with the following qualifications. The VOA and BNA data package contained calibration outliers as noted in initial and continuing calibrations and were subsequently flagged "j". The initial standard recoveries for samples CF-SO-1 (BNA), CF-SO-4, CF-SE-8 and CF-SE-7 (VOAs) indicated recoveries outside the QC limits. Tentatively identified compounds (TICs) were found in the laboratory blank. These contaminants are laboratory derived. Phthalate contamination was also detected in the blanks with a subsequent "j" flag attached. Surrogate recoveries for samples CF-SO-1 and CF-SW-2 were diluted out thus determination of QC for surrogate recoveries is impossible. Additional samples requiring dilution having positive results were flagged "j".

The holding times for sample CF-SW-10 were missed by one day. No flags were added to the data as no target compound list compounds were found in the sample runs. The two high concentration organic samples (CF-OP-1 and CF-OP-2) were analyzed according to high concentration EPA protocol resulting in elevated detection limits and reporting in ppm. Initial and continuing calibration was met except for 2-butanone, acetone, 4-nitroaniline, 3,3' dichlorobenzidine, octachlorodiphenyl and 4-nitrophenol. Upon review of organic analytical data for sediment sample CF-SE-5, the FIT has deleted the sample results and are not

included in this report. The FIT feels that organic compound quantity values reported were not consistent with observations made during the investigation. A further discussion is presented in the Conclusions, Section 11.0.

8.2 INORGANIC DATA

The holding times for all samples, initial and continuing calibration criteria were met as per specified guidelines. All ICP Interference Check Sample results and Laboratory Control Sample (LCS) results met contract criteria. The preparation blanks for both soils/sediment and water had several outliers. Soil outliers included iron, manganese and zinc. Aluminum, calcium, iron, and zinc are considered water outliers. All positive hits less than five times the amount found in the blank are flagged "j" as estimated. The ICP serial dilution analysis had one outlier for water (zinc) and one outlier for soils (sodium). All associated positive hits were flagged "j".

9.0 ANALYTICAL RESULTS

Analytical results for sampling activities conducted at CFAC are compiled in tables 2 through 14 of this report. Sample locations corresponding to the data are illustrated in Figure 5. Table 1 describes sample types, locations and rationales for samples collected during the investigation. A review of the analytical data allows the following observations to be made.

9.1 SOIL AND OPPORTUNITY SAMPLES

The collection of wastes deposited at various locations on the CFAC facility served to indicate the nature and extent of contaminants deposited at the site. It was the intent of the FIT to collect soil and opportunity samples at those locations in order to gain an understanding of the waste characteristics correlative to offsite migration.

9.1.1 Organic Results

Three soil samples were collected during the investigation (Table 5 and Figure 5). On-site background soil conditions were exemplified by CF-SO-4. A review of the organic analytical data indicates that several compounds were detected, and will serve as a basis for reviewing compounds at downgradient locations. Soil sample CF-SO-2 was collected at an augered depth of 2.5 feet in the closed landfill. The following compounds listed were identified in CF-SO-2; acenaphthylene, 51 times greater than background; benzo(a)anthracene, 5900; chrysene, 45; benzo(b)fluoranthene, 22; benzo(a)pyrene, 44; benzo(g,h,i)perylene, 43; dibenzofuran, 190; and fluorene, 610. Methylene chloride was also found in CF-SO-2 and is most likely attributable to laboratory contamination as it is used to clean lab glass ware.

In order to partially characterize wastes deposited at the spent pot liner/leachate pond complex a sample of the facility treater dust was collected. This sample, designated CF-OS-1, contains significant concentrations of polynuclear aromatic hydrocarbons (PAH). Most notable compounds exhibiting very high concentrations relative to background concentrations are: phenanthrene, 2235 times greater than background; fluoranthene, 2735; pyrene, 1433; benzo(a)anthracene, 110000; chrysene, 578; benzo(k) fluoranthene, 512; benzo(a)pyrene, 781; indeno (1,2,3-cd) pyrene, 480; dibenzo (a,h) anthracene, 24000 and benzo(g,h,i) perylene, 464. Toluene, 1000 ppb; dibenzofuran, 7500 ppb and bis(2-ethylhexyl)-phthalate, 5000 ppb were also detected in CF-SO-1. Two additional opportunity samples were collected pursuant to observations made during field activities. Sample CF-OP-1 was collected from the covered sludge pond. This sample also contained PAH compounds including fluoranthene, 10,000 ppb; pyrene, 9,000 ppb; benzo(a)anthracene, 2300 ppb and benzo(b)fluoranthene, 3700 ppb. As previously mentioned, spent carbon cathode material used in the aluminum reduction process is deposited at the spent pot liner/leachate pond complex. Opportunity sample CF-OP-2 was collected as representative of this material. This sample also exhibits high concentrations of PAH compounds including acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene,

benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno (1,2,3-cd) pyrene, dibenzo(a,h)anthracene and benzo(g,h,i) perylene at respective concentration (ppm) of 85, 63, 800, 210, 1700, 1400, 1000, 1200, 1200, 760, 1100, 690, 60 and 640.

9.1.2 Inorganic Results

Inorganic analysis of soil samples CF-SO-1 and CF-SO-2 show very consistent reporting of concentrations relative to background concentrations. Only lead (3 times greater than background) at 52 ppb and vanadium (4.6 times greater than background) at 65 ppb are notable in soil sample CF-SO-1.

The inorganic analysis of the opportunity samples show elevated levels of certain elements. Aluminum, 14800 ppm and magnesium 6039 ppm were shown to exist in CF-OP-1. Aluminum, 60,500 ppm; iron, 28700 ppm; manganese, 102 ppm; sodium, 34,100 ppm; and cyanide, 63 ppm were found in CF-OP-2.

9.2 GROUND WATER SAMPLES

Nine ground water samples were collected during the investigation. Additionally, three blank samples were prepared for QA/QC purposes.

9.2.1 Organic Results

Bis(2-ethylhexyl)phthalate and toluene were the only two positively identified organic compounds in all of the well samples. Bis(2-ethylhexyl)phthalate was evident at concentrations of 7 ppb, 8 ppb, 6 ppb, 5 ppb, 7 ppb and 5 ppb in samples CF-MW-1, CF-MW-2, Muni #2, CF-PW-7, CF-PW-8 and CF-TW-10 respectively. Toluene was present in the field prepared blank sample CF-MW-6 at 11 ppb. Toluene may have been introduced to the sample during field preparation. Based on the review of the organic ground water data, release of an on-site contamination to the ground water has not occurred.

9.2.2 Inorganic Results

Inorganic ground water analysis show elevated levels of barium in Muni #2 and CF-TW-8. In comparison to the background sample (CF-MW-1), barium is shown to be 6.4 times higher in Muni #2 and 3.8 times higher in CF-TW-8. Attribution of barium to the CFAC site is doubtful and may have been introduced in completion materials during construction of the wells. Zinc was also 8.3 times higher in CF-TW-8, 2.2 times higher in CF-TW-11, 6.4 times higher in CF-TW-10 and 3.6 times higher in CF-TW-3 in relation to upgradient (CF-MW-1) concentrations. Most notably, cyanide was detected in two of the downgradient wells. Ground water from CF-MW-2, installed during the investigation, contained 666 ppb cyanide. Similarly, the existing well TW-2 contained 53 ppb cyanide. A review of past sampling conducted at the CFAC site from 7/11/80 to present indicates the cyanide concentration is remaining consistent for ground water in TW-2. Additional review of CLP data indicates a decrease in cyanide concentrations in the existing wells PW-7, TW-8, TW-10, TW-3 and TW-11. The high concentration of cyanide in sample CF-MW-2 is most likely due to wastes deposited at the north percolation/boiler blowdown pond. Section 9.5 of this report contains information regarding surface water and sediment characteristics for the above specified pond.

9.3 SURFACE WATER AND SEDIMENT SAMPLES

The collection of surface water and sediment samples was performed in order to delineate background conditions for two sources (Flathead River and Cedar Creek/Flood Control Ditch) and also to characterize the nature and extent of contaminant migration from the site. A total of nine sediment and seven surface water samples were collected.

9.3.1 Organic Results

Background surface water/sediment characteristics in the Flathead River are exemplified by CF-SW-9 and CF-SE-9. No significant organic contamination was found to exist in surface waters at the

upgradient/background location. The sediment sample collected at the upgradient location contained 230 ppb chrysene, 320 ppb benzo(b)fluoranthene and 84 ppb benzo(a)pyrene. Surface water sample CF-SW-8 was collected from the plant effluent at the south percolation ponds. No organic contamination was discovered during CLP analysis. Sediment sample CF-SE-8, collected at the same location as CF-SW-8, exhibited concentrations of PAH compounds as high as 130,000 ppb. Characterization of contaminant migration to the Flathead River is represented by surface water and sediment samples CF-SW-2 and CF-SE-2. No organic surface water contamination was observed at that location. Sediment sample CF-SE-2 contained PAH compounds as high as 580 ppb. Surface water sample, CF-SW-3 exhibited no observable contamination. The downgradient sediment sample CF-SE-3 contained minor amount (41 ppb, benzo(b)fluoranthene) of PAH compound.

Sample CF-SW-5, representing background conditions for the flood control ditch and Cedar Creek contained no detectable contamination. As previously mentioned, sediment sample CF-SE-5 was deleted from the analytical results. A significant release with respect to background conditions of onsite organic contamination in the flood control ditch (CF-SE-4) was not detected. PAH compounds were shown to exist at that location, however the concentrations reported are not significant enough to warrant concern. Additionally an offsite release of organic compounds via the flood control ditch (CF-SE-1) was not observed in comparison to background concentrations. Cedar Creek appears to have received contamination from the CFAC site. PAH compounds are shown to be present in sediment CF-SE-6. The largest concentration detected at this location is 840 ppb, indeno(1,2,3-cd)pyrene. No contamination was detected in surface water in Cedar Creek.

Onsite surface water and sediment from the North Percolation/Boiler Blowdown pond exhibited the highest organic contamination during the investigation (Tables 5 and 7). PAH compounds were detected in CF-SW-7 as high as 500 ppb (acenaphthalene). Additionally, phenol, 42 ppb; 2-methylphenol, 50 ppb; 4-methylphenol, 69 ppb and dibenzofuran, 130 ppb were detected in surface waters at that location. Sediment collected

from the North Percolation/Boiler Blowdown Pond is host to very high concentrations of PAH compounds (Table 5). Compounds exhibiting concentrations greater than 1,000,000 ppb include phenanthrene, fluoranthene, pyrene, benzo(k) fluoranthene and indeno(1,2,3-cd)pyrene.

9.3.2 Inorganic Results

Upgradient surface water (CF-SW-9) analysis serves as a basis for comparison at downgradient locations. Due a transcription error, the laboratory did not analyze for cyanide at that location. Cyanide concentrations in sediment at CF-SE-9 were not detected. Cyanide concentrations of 55 ppb (detection limit for cyanide analysis is 10 ppb) were detected in surface water from the Flathead River adjacent to the site (CF-SW-2). This elevated cyanide concentration is not found in sediment at that location. The cyanide concentrations in the Flathead River may be attributable to the CFAC effluent to the south percolation ponds where cyanide was detected in surface water (CF-SW-8) at 18 ppb. Downgradient inorganic concentrations in surface water and sediment from the Flathead River (CF-SW-3 and CF-SE-3) show very consistent reporting of concentrations in comparison to upgradient concentrations. Additionally, samples CF-SW/SE-2 and CF-SW/SE-8 exhibited similar concentrations of inorganic contaminants, excluding cyanide, as shown in background samples.

Surface water and sediment sample CF-SW/SE-5 was collected as a background for both the flood control ditch and Cedar Creek. Sediment sample CF-SE-4 (no surface water available at time of collection) shows elevated levels of iron, four times higher than background, manganese, three times higher and aluminum at three times background concentrations. Further downstream releases of contaminants were not detected in sediment sample CF-SE-1. Similarly, no inorganic contamination to Cedar Creek was observable. Only aluminum was slightly elevated at 1.5 times greater than background in Cedar Creek sediment (CF-SE-6) and three times greater than background in surface water (CF-SW-6). Contact cooling water from the CFAC plant exhibits increased concentrations of aluminum, barium, iron, vanadium, zinc and cyanide.

The contact cooling water CF-SW-7 is shown to be 42 times higher than CF-SW-5 for aluminum, 24 times higher for lead, 14 times higher for vanadium, 15 times higher for zinc and cyanide was reported at 19 ppb.

10.0 CLP AND SCREENING DATA REVIEW

The following review is presented as a comparison between screening data collected during the field investigation and CLP data. As previously mentioned, the CLP detection limit for cyanide is 10 ppb. The detection limit for the infield screening equipment used during the investigation is 0.12 ppm. Table 15 and 16 contain screening data correlative to CFAC sampling in April, 1988. It is shown that due to a high detection limit for surface water screening samples, no cyanide was detected. CFAC's use of a lower detection limit for their April, 1988 analysis indicates the presence of cyanide concentrations of 0.002 ppm, 0.009 ppm and 0.005 ppm for samples CF-SW-2, CF-SW-7 and CF-SW-8 respectively. Comparative analysis of CFAC data to CLP data indicates cyanide levels at CF-SW-2 have risen from 0.002 ppm to 0.055 ppm. The cyanide level in the north percolation/boiler blowdown pond (CF-SW-7) has also risen from 0.009 ppm to 0.019 ppm. A similar increase in cyanide is notable in surface water from the south percolation pond. Cyanide has increased from 0.005 ppm to 0.018 ppm at that location.

A further review of ground water results show that slight increases in cyanide concentrations have occurred since the CFAC analysis in April, 1988. An increase from 0.022 ppm, CFAC data, (0.015 ppm were detected during FIT screening) to 0.053 ppm is notable in sample CF-TW-2. Additional cyanide concentrations in the other onsite existing wells were not detected in CLP analysis.

11.0 CONCLUSIONS

As is evident from samples collected at the CFAC facility, the aluminum manufacturing process is producing high levels of PAH compounds in excess of 2300 ppm. These high PAH concentrations are primarily found to exist in soils and sediments associated with plant processes.

The analysis of samples collected indicate a release of cyanide to ground water and surface water which is also attributable to plant processes.

In review, onsite surface waters including the north and south percolation ponds, are receptacles for high concentrations of PAH compounds. These compounds were shown to be slightly elevated in Cedar Creek when comparing to background conditions. A release of organic compounds does not appear to have occurred via the flood control ditch. Additionally, organic compounds have not been released to the Flathead River. Cyanide does appear to have been released onsite and is shown to be migrating from the site to the Flathead River possibly from the South Percolation Ponds. As previously mentioned cyanide was found in surface waters from the Flathead River at concentrations of 55 ppb. This is most likely attributable to the south percolation ponds as cyanide is evident (18 ppb) at that location.

Ground water at the CFAC site has also been contaminated with cyanide. A review of past analytical data suggests that cyanide concentrations are decreasing at some locations, however significant quantities of cyanide are still evident in the ground water. Well CF-MW-2, located 100 yards hydrogeologically downgradient of the north percolation/boiler blowdown pond, exhibited concentrations of 666 ppb cyanide. The existing well TW-2 also contained 53 ppb cyanide. Organic contaminants associated with the site do not appear to have been released to the ground water. Based on CLP data, the Columbia Falls backup municipal supply well does not contain contamination from the CFAC facility.

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